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Division of Truck Crops
Davis, California

TRANSIT STUDIES WITH TOMATOES

~~FIDENTIAL~~

Progress Report, 1942 1/

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The purpose of the transit studies reported here was to ascertain what shipping methods are most likely to result in desirable ripening temperatures for California tomatoes shipped at various seasons of the year. No records were heretofore available on this. Temperatures were obtained from small recording thermometers packed in the centers of the tomato lugs and forwarded in commercial shipments. Records were obtained in 16 cars from Merced and Le Grand, California during July, in three cars from Brentwood during October and in seven cars from Edison during November (Tables 2 A, 2 B, 3 A, and 3 B).

Some ripening during transit is usually desired. When the market is active, the receiver wants to lose little time in bringing green fruit to a marketable condition in his ripening rooms. Probably the arrival condition most often desired is to have about 25 percent of the fruit firm ripe and the remainder showing at least some color development.

It has been shown experimentally 4/ 5/, that when harvested in the mature-green stage, tomatoes have a definite temperature range that they will tolerate for proper ripening. The extremes of this range are 50° and 80°F. Under commercial conditions, the ripening temperature for tomatoes should be maintained within the range from 55° to 75°F. Fastest ripening occurs at a temperature of about 75°, or slightly above, but the fruits are of better color and less likely to show shrivelling, when ripened at a temperature of about 65°. The effect of temperature upon ripening is shown in Table 1.

1/ Part of a cooperative investigation of methods of handling and shipping truck crops conducted by the U. S. Department of Agriculture and the California Agricultural Experiment Station.

The aid of C. O. Bratley, G. B. Ramsey, E. V. Shear, M. A. Smith and J. S. Wiant, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, U. S. Department of Agriculture, in inspecting and ripening the fruit at destination is acknowledged. Appreciation is also expressed for the cooperation of La Mantia Bros. Arrigo Co., Strazzula Bros., Safeway Stores, Inc., H. P. Garin Co., Irving Williams Co., in making possible the shipping tests.

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4/ Rosa, J. T. Ripening and storage of tomato. Proc. Amer. Soc. Hort. Sci. 1926: 233-242.

5/ Wright, R. C., Pentzer, W. T., Whiteman, T. M., and Rose, D. H. Effect of various temperatures on the storage and ripening of tomatoes. U. S. Department of Agriculture Tech. Bul. 268. 1931.

Table 1 - Tomato Ripening Occurring at Various Temperatures During One Week Storage

Temperature	Per Cent Green	Per Cent Turning	Per Cent Ripe	Remarks on Color
60°F	47	53	0	Normal
64	27	60	13	"
70	13	64	23	"
77	13	57	30	"
83	13	84	3	Abnormal-Yellow

At temperatures above 80°F, red color development is inhibited, resulting in fruits with an uneven and yellowish color. At the low extreme (50°) ripening is so slow that decay and abnormal flavor frequently develop before the fruit is ripe. Although it has been shown 5/ that exposure of mature green tomatoes at temperatures of 40° or below does not necessarily prevent subsequent ripening when transferred to a good ripening temperature, such exposures are likely to have a retarding effect on the ripening process. One experiment indicates that an exposure of tomato fruits at 32°F for five days resulted in poor and abnormal ripening when transferred to a favorable ripening temperature. Rosa 4/ has pointed out that the low temperature relations of tomato fruits are important in handling commercial shipments. He states that a period in a refrigerator car of 10 days or more at 40° to 45° might be the cause of extensive decay and retarded ripening when the fruits are transferred to a ripening room.

Another condition affecting the temperature requirements of tomatoes from certain districts results from the fumigation of the fruits with methyl bromide for the control of pin worm. It has been shown 6/ that tomatoes should not be exposed to temperatures as low as 50° following fumigation. Due to removal of the fumigation requirement by certain states this factor is of reduced importance but should be borne in mind whenever fumigation is required.

Thus it is seen that the tomato shipper is faced with rather exacting requirements in regard to maintaining the proper temperatures during transit. Tomatoes are shipped at different seasons during which the air temperatures at time of loading may vary from 50° to 110°. In addition the length of the transit period may make rapid ripening desirable at one time and slow ripening desirable at other times. During the warm season, the problem is usually one of maintaining a temperature low enough for proper ripening; whereas, during the fall and winter the problem may be reversed.

Under the different methods of shipment, the following rules apply: When a preiced car was used, the bunkers were iced to capacity before the car was delivered to the packing house. The car was not replenished with ice after loading or reiced in transit unless so ordered. "Dry cars" indicate that they were loaded before any ice was placed in the bunkers. Some cars, loaded dry, were iced en route and others were forwarded under ventilation without ice. During shipment of dry cars to the icing station and shipment under standard ventilation, the ventilators of the car were left open whereas after icing only one at each end, on opposite

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6/ Morris, L. L. and Claypool, L. L. Some practical observations regarding methyl bromide fumigation of tomato fruits. California State Department of Agriculture. Bul. 31 : 76-79. 1942

sides, were left open. The standard practice with tomatoes is to close all vents of both iced and ventilated cars whenever the outside temperature drops to 45° F, or below. The ventilation of iced cars is not a common practice except with commodities such as tomatoes that can be harmed by low temperatures.

Transit Temperatures of Summer Shipments from Merced and Le Grand, Calif.

Much of the summer tomato crop that is shipped goes to West Coast and Rocky Mountain cities and has a transit period of 5 to 7 days. As a result a maximum ripening rate is usually desired for mature green fruits. At this time of the year, the air and pulp temperatures at time of loading are often well above the range that will permit proper ripening. Although it has been shown [5] that short exposures to high temperatures do not inhibit color development, it would seem desirable that tomato fruits be lowered to the ripening range (55° to 75° F) within a few hours after loading. Records were obtained on 16 cars loaded at Merced and Le Grand, California during June and July of 1942. These cars were shipped by Safeway Stores, Inc.

Temperatures under ventilation - Test car 12 was loaded July 18 and was shipped to Seattle, Washington under standard ventilation. The car was billed out under standard ventilation; the order was changed to "ice-in-transit" but from the record it is obvious that the car was not iced. From Table 2 B and Fig. 1 it is apparent that the fruits in this car were at a temperature too high for proper ripening. Test car 13 was shipped under similar orders but it was either iced in transit or the outside temperature was low enough to cool the contents to a desirable temperature after about 4 days.

In addition to the above cars, those cars which received ice in transit were shipped under standard ventilation to the icing station. It is obvious from these records that shipment under standard ventilation at this time of the year may be expected to result in undesirably high transit temperatures.

Temperatures under refrigeration - Most of the test cars from Merced were iced. Some cars were preiced, and some received initial ice at Roseville or at Stockton, California on the first or second day after loading. Two diagonal ventilators were left open after icing. The transit temperatures of the test cars are shown in Table 2 B. Temperatures of test cars 8, 12, and 14 are shown graphically in Fig. 1. It is seen that when ice was used, the top part of the load was at a desirable temperature.

Only a few records were obtained on these summer shipments which show the range in temperature existing within a car at a given time. Fig. 2 shows the temperatures existing in different locations of test cars 7 and 8 shipped July 15 to Denver and Pueblo, Colorado, respectively. It is seen that a range of about 20° F existed between the warmest (top layer) and the coldest part (bottom layer at bunker) of the car. Hence some of the fruits were at a good ripening temperature whereas other fruits in the same car were at a temperature at which practically no ripening will occur. The records indicate that the tomatoes in the top half of the iced cars were within the desirable temperature range. The bottom layer is considerably colder and those lugs nearest the bunkers may be undesirably cold. However, it is concluded that during the hot season, icing of the cars (with diagonal ventilators open) is preferable to standard ventilation despite the undesirable low temperatures in the bottom layers.

All iced cars with the exception of test car 5 were shipped with the instruction that one ventilator on each end of the car (diagonal) be left open after icing. Car 5 was loaded dry, iced to capacity at Roseville, and all ventilators closed between Roseville, California and Klamath Falls, Oregon. From Klamath Falls

to destination one ventilator was open at each end of the car. This car is directly comparable with car 6 which was loaded on the same day and received comparable treatment except that diagonal ventilators were open at all times subsequent to icing. From a practical standpoint, the rate of cooling of these cars immediately after icing was essentially the same. However, car 5 cooled somewhat faster and to a lower temperature due to the fact that the ventilators were closed and less refrigeration was lost. Car 4 is also comparable to the above cars. It was a preiced car and was reiced at Klamath Falls. As to be expected, this car started to cool at an earlier time than the preceding cars and it cooled to a lower temperature. The record indicates that this car would have remained in a more desirable ripening range had it not been reiced at Klamath Falls.

Transit Temperatures of Early Fall Shipments from Brentwood, California

A large percentage of the fall-shipped tomatoes are sent to Eastern cities and thus they have a transit period of 10 to 14 days. In early fall the air and pulp temperatures are such that some cooling may be desirable especially for the long distance shipments. Fairly complete temperature and ripening records were obtained on three different cars shipped from Brentwood during October. These shipments offer a comparison between a standard car, a fan car, and a stage iced car.

A standard car (car 17, destination Boston) was compared with a fan car (car 18, destination New York) shipped on the same day from Brentwood in October. The fan car was equipped with axle driven fans (Preco) located under the floor racks. With these fans in operation, the normal circulation of air in the car is reversed in direction, by forcing the air from under the floor rack up through the bunkers. In this test, the standard car was iced to capacity (10,500 pounds) at Brentwood on the morning after loading and the fan car, iced at the same time, was filled to about 3/4 capacity (8,000). One ventilator was opened at each end of both cars for the first four days of the trip (Brentwood, California, to Ogden, Utah) and then all ventilators were opened to destination.

Several days later a stage iced car (car 19) was shipped from Brentwood to New York. This car was equipped with adjustable ice racks which were raised about 3 feet from the floor confining the ice to the upper part of the bunker. The ice capacity of the stage-iced car was about 3,000 pounds at each end making a total of about 6,000 pounds or about 60 percent of its full capacity. This car was also iced at Brentwood on the morning after loading and was forwarded under the same method of ventilating and with substantially the same routing as used for cars 17 and 18.

Transit temperatures obtained in the bottom layer near the bunker, middle layer midway between the bunker and the door (quarterlength) and top layer near the door are given in Table 3 B and are charted in Figures 3, 4, and 5. Temperature of the various positions followed the same general trend in all cars. Starting at 67° to 77° the fruit warmed up somewhat before icing but began to cool soon after the cars were iced. The temperature dropped at a fairly uniform rate of 3° to 5° a day for the first 4 or 5 days while there was ice in the bunkers. During this time the bottom layers were the coldest and at times were 10° to 15° colder than the warm part of the load. Top and middle layers held about the same temperature in the standard car whereas top and bottom layers were about the same in the fan car due to the effect of the fans circulating cold air over the top of the load. The reasons for the top doorway position in the stage iced car being considerably colder than the middle quarterlength are not readily apparent, but it is probably due to better circulation because of half stage icing.

The temperature of the bottom layer in the fan car did not drop as low as it did in the two cars without fans. This may be due in part to the fact that the initial temperatures of this car were considerably higher. However the fans undoubtedly helped to keep this part of the car from being cooled as much as otherwise would have occurred.

Transit Temperatures of Late Fall Shipments from Edison, California

During the late fall, air and pulp temperatures at time of loading are usually sufficiently low to make additional cooling undesirable. In addition, the cars can be expected to be moving into areas of cool outdoor temperatures. As a result, most of the cars shipped during the late fall move under standard ventilation with the usual provision that the ventilators be closed whenever the outside temperature drops below 45°F. Temperature records were obtained on 7 cars shipped from Edison (Irving Williams Co. - Algoso) during November.

These recrods show that these cars were moving under desirable conditions so far as a ripening temperature range is concerned. Despite this these cars arrived in Chicago with most of the fruits in a green condition. This point is discussed in the next section.

In regard to the temperature extremes existing within a car, there was a much narrower range for these cars moving under standard ventilation than for the cars moving with ice in the bunkers. During tests from Texas in 1933, the Freight Container Bureau of the American Railway Association found that with cars of tomatoes under standard ventilation the range of air temperature throughout the load was quite narrow. 7/

Test cars 25 and 26 (Table 3 B) offer a comparison between a standard car and a fan car. A comparison of these cars indicates that there is no advantage to be derived from the use of a fan car when the car is moving with all ventilators open and with no ice in the bunkers.

Arrival Condition of the Various Shipments

Information regarding ripening in transit is given in Tables,4, 5, and 6. The inspections at Chicago, New York, and Boston were made by representatives of the Bureau of Plant Industry of the U. S. Department of Agriculture. Only limited information is available regarding the cars shipped from Merced and this information was supplied by the receivers.

It is readily apparent that there were marked differences in the ripening occurring in the various cars. The effect of temperature as determined by position in the car is clearly shown by the records of the Brentwood cars, Table 5. In test car 17 the fruits developing color varied from 8 per cent in the coldest part to 66 per cent in the warmest part of the car. This relationship between position in the car, transit temperatures and ripening is illustrated by Fig. 7. The ripening occurring in transit is in agreement with that observed for tomatoes from the same packing shed that were held in constant temperature rooms at Davis. At 50° very few fruits developed color in this period; whereas, at 65° most of the fruits were showing some color. This brings out very clearly the effect of temperature upon the ripening rate of tomatoes and in addition illustrates the variation that can occur within a given car. Obviously, if uniform ripening throughout the car is desired, steps must be taken to maintain a more uniform temperature.

7/ Temperature conditions in carloads of tomatoes during rail transportation. American Railway Association, Freight Container Bureau Report April 15, 1934.

Lugs of tomatoes from test car 17 were ripened in the laboratory at New York City at a temperature of 68° to 70° with high humidity. Fruits from the bottom bunker, top doorway, and middle quarterlength positions following average transit temperatures of 55°, 58°, and 62° arrived 48, 26, and 2 per cent green, respectively and required on the average 6, 4½, and 3 days to ripen.

The test cars shipped from Edison showed great variation in regard to ripening during transit (Table 6). In general, the test cars from Edison arrived much greener than the test cars from Brentwood which were loaded earlier in the season. The transit temperatures of these cars were in the same general range. Much of this difference was due, no doubt, to a shorter transit period for most of the Edison test cars. Thus, it is seen that cars 21, 22, 23, and 24 shipped to Chicago from Edison were intransit 10 and 11 days and arrived mostly green. Whereas, test cars 17, 18, and 19 shipped to the eastern coast from Brentwood were in transit for 12 and 13 days and arrived in a much riper condition. Ripening as judged by development of red color proceeds slowly during the first 10 days in transit and then accelerates rapidly. One car from Edison was in transit for 14 days and its arrival condition compared favorably with the Brentwood cars. Although the time and temperature in transit were probably the most important factors governing the ripening, there may have been other factors. It has been shown by Rosa [4/] that mature-green tomatoes harvested in late fall ripen more slowly than those harvested earlier in the season. Also, there may have been differences in the degree of maturity between the two shipping points. It is also possible that the two varieties (Pearson at Edison; 133-6 at Brentwood) differ somewhat in their behavior. However, this possibility appears rather remote in comparison with the others.

The reports from the receivers (Table 4) of some of the cars shipped during mid-summer indicate that these cars showed considerable ripening for the short transit period envolved. The faster ripening of these tomatoes as compared with fall shipments may have been due in part to better maturity. Also, it is possible that fruit grown at this time of the year will ripen faster than fruit grown during the late fall. The data are not complete enough to permit rigid comparisons between the various cars shipped from Merced and Le Grand. However, it is of interest to note that those cars (Test 12 and Test 13) which had high transit temperatures arrived in a greener condition than did those cars which were cooler.

Commercial Considerations

These tests in which mature-green tomatoes were shipped under different methods of refrigeration and ventilation and at different seasons of the year show that widely different temperatures occur in transit depending on the method and the time of year. As to be expected, the transit temperature and the time en route are important factors in determining the amount of ripening. Although these results apply to only one year, the generalizations regarding temperatures under various shipping conditions should be valid. The results of these tests and the information available on ripening of tomatoes indicate that transit temperatures between 55° and 75° seem most desirable for the shipment of sound mature green tomatoes from California. Temperatures of 65° to 75° appear desirable when the transit period is 10 days or less and 55° to 65° for the longer hauls of 12 to 14 days.

Summer Shipments. It was found that standard ventilation at this time of the year may be expected to result in too high a temperature for proper tomato ripening. Icing of the car and having one ventilator (diagonal) open at each end resulted in a more desirable temperature. Icing of the car before loading resulted in faster cooling of the load than did delayed icing in transit. There was a considerable temperature range within the iced cars and the lower part of the load was often at too cold a temperature for proper ripening. None of the iced cars showed need of

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

reicing and the record of one preiced car that was reiced in transit indicated that the added cooling was probably undesirable from the standpoint of ripening. It appears that the use of preiced cars would be desirable under conditions of extremely hot weather. The above applies to cars shipped to West Coast and Rocky Mountain cities.

Other improvements suggest themselves but can not be recommended until given trial. For example, it would appear desirable to eliminate the large volume of air that passes through a car with open ventilators and hence reduce shrinkage which is a common defect of tomatoes that have been picked green. It also appears desirable to eliminate the wide temperature differences that now exist in iced cars. It would be desirable to have information on the following: (a) One ventilator open as compared to one on each end. (b) Use of a minimum amount of ice and all ventilators closed, with reicing if necessary. (c) Use of a small amount of ice in upper part of bunker and ventilators closed. (d) Use of fan cars.

Fall Shipments. From the records obtained it appears that during early fall it is desirable to have initial ice (with diagonal vents open) if the transit period is to be long. A fan car and a car with stage icing were compared with a standard full bunker car in shipments to the eastern seaboard. The fan car maintained temperatures between 55° and 75° and arrived 6 to 16 per cent green after 13 days en route. The car with stage icing maintained temperatures of 48° to 63° and arrived with 2 to 48 per cent green after 13 days. The standard car had temperatures from 45° to 65° and arrived with 34 to 92 per cent green after 14 days. All three cars were acceptable to the market. The fan car was somewhat warmer during the trip but this was probably due in part to the fact that this car started at a warmer temperature than did the other two cars. However, tests with other fruits have shown that the bottom layers of fan cars are usually warmer than those of standard cars. Another comparison which envolved a fan car and a standard car shipped from Edison without ice indicates that fans have little effect on the temperature of the load when shipped under standard ventilation.

The cars shipped during November from Edison were under standard ventilation with the usual provision that ventilators be closed when the air temperature is below 45°. It is obvious that icing would not be desirable for mid and late fall shipments. In general, these cars were at a desirable ripening temperature but they arrived in a green condition, for the most part. It would appear that for these cars it would be desirable to make an attempt to maintain the temperature in the range between 65° and 75° rather than in the range of 65° and below. This might be accomplished by shipping the car with one or possibly two ventilators open (manipulated according to standard ventilation for tomatoes).rather than having all ventilators open. This point should be investigated. From the standpoint of ripening it would probably be desirable to delay fall shipped cars so as to have a transit period of 12 to 14 days. However, in view of the present car shortage this practice cannot be recommended.

It is recognized by the trade that tomatoes are more apt to develop decay in transit when harvested late in the season than are the earlier fruits. For this reason it is desirable that such tomatoes be ripened and sold in a minimum length of time. More information is needed concerning desirable ways of handling these late fall tomatoes.

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Table 2 A - List of shipping tests with tomatoes from Merced and Le Grand, California, 1942

Test Car	Car Number	Date shipped	Destination	Routing	Shipping instructions 1/	Test involved
1	PFE 15940	6/30	El Paso, Tex.	S. P.	Initial ice Los Angeles	Record of air temperature at doorway
2	PFE 18024	7/13	Butte, Mont.	S.P.-OSL	Initial ice, Roseville, California	Preicing vs. delayed icing
3	PFE 14317	7/13	Denver, Colo.	S.P U.P. D. & R.G.	Preiced, not reiced	do.
4	PFE 44500	7/13	Seattle, Wash.	S.P. N.P.	Preiced, reiced 1 ton each end at Klamath Falls, Oregon	do.
5	PFE 29365	7/14	Seattle, Wash.	S.P. N.P.	Initial ice at Roseville 2/	do.
6	PFE 38253	7/14	Seattle, Wash.	S.P. N.P.	Initial ice at Roseville	do.
7	RD 32879	7/15	Denver, Colo.	S.F. W.P. D. & R.G.	Initial ice at Stockton	do.
8	PFE 71837	7/15	Pueblo, Colo.	S. P. D. & R.G.	Preiced, not reiced	do.
9	PFE 91252	7/16	Denver, Colo.	S. P. D. & R.G.	Initial ice Roseville	do.
10	RD 34310	7/17	Salt Lake City	S.F. W.P.	Initial ice Stockton	do.
11	PFE 75804	7/17	Denver, Col.	S. P. D. & R.G.	Initial ice Roseville	do.
12	PFE 92196	7/18	Seattle, Wash.	S.P. N.P.	Standard ventilation	Ventilation vs. refrigeration
13	PFE 71742	7/20	Seattle, Wash.	S.P. N.P.	Initial ice Roseville or Klamath Falls	do.
14	PFE 92330	7/21	Seattle, Wash.	S.P. N.P.	Initial ice Roseville	do.
15	PFE 35786	7/21	Seattle, Wash.	S.P. N.P.	Initial ice Roseville	do.
16	PFE 74994	7/21	Seattle, Wash.	S.P. N.P.	Initial ice Roseville	do.

1/ All vents were left open prior to icing;after icing, one vent was left open at each end on opposite sides of the car.

2/ Vents closed from Roseville, California to Klamath Falls, Oregon.

Table 2 B - Transit Temperatures of Test Cars From Merced and Le Grand, California Summer 1942

Test Car	Date Shipped	Location of Thermograph 2/	Transit Temperature at Indicated Hours After Loading										
			0	10	20	30	40	50	75	100	125	150	200
1	6/30	Above load	90	87	92	95	87	88	70	73	72		
2	7/13	T.D	78	80	82	83	81	78	(Thermograph failed)				
		2 Q	75	76	79	83	84	81	69	60	55	55	
3	7/13	T D	79	76	72	69	66	65	65	67	70		
4	7/13	T D	81	76	70	67	65	63	58	56			
		T B	72	69	66	65	65	65	58	56			
5	7/14	T D	78	78	78	77	73	68	59	57	60		
		T B - Rear	78	79	79	78	76	72	63	60	61		
6	7/14	T D	82	83	83	82	79	76	69	69	71		
		T B - Front	82	78	78	79	76	73	66	67	70		
7	7/15	T D	88	82	78	74	70	68	70	71			
		B B 3/	86	77	64	60	59	60	68				
8	7/15	T D	84	79	74	70	67	66	66	66			
		B B	85	65	54	49	46	46	45	54			
9	7/16	T D	79	80	76	72	67	64	61	61			
10	7/17	T D	82	79	74	68	66	67	68	72			
11	7/17	T D	84	82	78	74	69	68	63	63			
12	7/18	T D	84	84	86	85	86	85	83	82			
13	7/20	T D	98	96	94	93	91	88	77				
14	7/21	T D	85	84	82	76	72	70	67	69	70		
15	7/21	T D	75	77	77	79	76	73	66	66	67		
16	7/21	T D	86	86	88	81	76	72	70	70	71		

1/ See Table 1 A for information concerning car.

2/ All thermographs in tomato lugs except Test 1.
T D = Top at Doorway; B B = Bottom at Bunker; 2 Q = 2d layer at Quarterlength.

3/ This lug was in the 3d row from the bunker.

Table 3 A - List of shipping tests with tomatoes from Brentwood and Edison, California - Fall 1942

Shipment	Car Number	Date Shipped	Destination	Routing	Shipping Instructions	Test involved
17	PFE 44077	10/1	Boston, Mass.	S.P. D&RG CB&Q Erie NY. NH&H	Initial ice, Brentwood after loading 1/	Fan car and stage ice car
18	PFE 76059	10/1	New York City	S.P. U.P. Wab.Erie	Initial ice Brentwood Preco fans on 2/	do.
19	PFE 41541	10/21	New York City	S.P. U.P. Wab. Erie	Initial ice Brentwood stage icing 3/	do.
20	PFE 32924	11/5	Chicago, Ill.	Santa Fe	Standard ventilation	Northern vs. southern route
21	PFE 74846	11/6	Chicago. Ill.	S.P. R.I.	Standard ventilation	do.
22	PFE 96863	11/6	Chicago, Ill.	S.P. R.I.	Standard ventilation	do.
23	PFE 61211	11/7	Chicago, Ill.	S.P. R.I.	Standard ventilation	do.
24	PFE 92879	11/7	Chicago, Ill	S.P. R.I.	Standard ventilation	do.
25	PFE 45126	11/13	Chicago, Ill.	S. P. R.I.	Standard ventilation	Standard vs. fan car under ventilation.
26	PFE 76496	11/13	Chicago, Ill.	S.P. R.I.	Standard ventilation Preco fans on	do.

1/ Initially iced to capacity (10,500 lbs.) one vent open at each end to Ogden, Utah, standard ventilation beyond.

2/ Initially iced 4,000 lbs. each end. One vent open each end to Ogden, Utah, standard ventilation beyond.

3/ Initially iced 3,000 lbs. each end, using upper part of bunker, one vent open each end to Ogden, Utah, standard ventilation beyond.

Table 3 B - Transit Temperature of Test Cars from Brentwood and Edison, California, Fall 1942 1/

Test Car	Date Shipped	Location of Thermograph 2/	Transit Temperature (°F) at Indicated Hours after Loading												
			0	10	20	30	40	50	75	100	125	150	200	250	300
17	10/1	T D	74	74	72	70	68	66	61	57	56	56	64	60	58
		M Q	66	68	69	70	68	65	61	59	57	55	59	60	59
		B B	67	69	62	57	53	50	47	45	44	50	57	58	55
18	10/1	T D	77	79	78	75	74	72	67	61	58	60	68		
		M Q	74	77	78	80	81	80	76	72	70	68	71	72	
		B B	73	74	75	70	68	64	60	59	58	60	68	67	
19	10/21	T D	68	70	70	68	64	61	58	56	54	54	56	60	51
		M Q	68	72	72	71	69	67	65	62	59	59	60	61	55
		B B	68	70	67	62	57	54	50	50	48	50	57	56	51
20	11/5	T D	63	61	61	61	61	61	60	60	57	56			
21	11/6	T D	65	60	60	61	62	62	62	64	67	65	60	65	
22	11/6	T D	72	66	65	64	63	62	63	63	64	64	61	64	
		M Q	72	66	66	66	66	65	65	64	64	64	64	64	
		B B 3/	72	64	64	62	60	60	61	63	64	64	62	64	
23	11/7	T D	66	68	68	68	65	64	64	67	65	61	62		
24	11/7	T D	73	72	70	68	66	65	64	66	64	61	62		
		B B	70	60	60	60	58	56	60	68	60	55	59		
25	11/13	T D	75	76	77	78	78	77	75	63	62	64	61	57	56
		M Q	72	73	74	75	75	75	75	70	68	67	63	59	58
		B Q	70	70	72	73	73	73	73	63	60	62	60	56	55
26	11/13	T D	72	72	72	72	72	72	61	61	62	63	58	55	54
		T B	71	72	72	73	73	73	69	65	65	65	58	56	55
		T A	70	72	69	68	69	66	55	54	60	65	52	50	51

1/ See Table 2 A for information concerning car.

2/ All thermographs in tomato lugs except T A of Test 26.
T D = Top at Doorway; M Q = Middle at Quarterlength; B B = Bottom at Bunker; B Q = Bottom at Quarterlength; T A = Top Air

3/ In 3d row from Bunker.

Table 4. - Transit temperatures and ripening in transit of mature green tomatoes shipped from Merced and Le Grand, California in July 1942

Test No.	Date Shipped	Days en route	Transit Temperatures (Top at Doorway)		Per Cent Turning and Ripe on Arrival 1/
			Ave.	Min.	
2	7/13	6	2/		35
8	7/15	5	69	66	12-15
12	7/18	5	84	80	5
13	7/20	4	88	72	5-8
14	7/21	5	73	67	10
15	7/21	6	71	66	25
16	7/21	5	75	70	8

1/ As reported by receiver - lugs from both ends and center of car were inspected.

Note: The amount of ripening is not directly comparable to the transit temperature given since the temperature is for the warmest part of the car and the ripening data apply to the "average" for the car.

2/ Thermometer failed en route.

Table 5 - Transit temperatures and ripening in transit of mature green tomatoes shipped from Brentwood, California in October, 1942

Test No.	Date Shipped	Loading point	Loading temp.	Type of car	Time en route	Position in car	Temperature en route		Condition on arrival					
							Av.	Min	Grn.	Pink	Red	Ripe	Decay	Virus
			°F		Days	1/	°F	°F	pct.	pct.	pct.	pct.	pct.	pct.
17	10/1	Brentwood	69	Standard	13	M Q	66	59	34	40	25	1	1	15
						T B	64	60	40	40	20	0	0	0
						T D	62	57	36	34	28	2	0	5
						M Q	61	54	62	32	6	0	0	0
						T B	2/	56	41	34	25	0	0	15
						B D	58	46	55	34	11	0	0	10
						B B	55	48	82	13	5	0	0	0
						B B	53	44	92	6	2	0	0	20
18	10/1	Brentwood	75	Fan Car	12	M Q	73	68	6	42	44	8	0	--
						T D	68	58	16	49	30	5	0	--
						B B	65	58	11	49	32	8	0	--
19	10/21	Brentwood	68	Stage ice	13	M Q	62	59	2	49	48	1	0	--
						T D	58	53	26	51	22	1	0	--
						B B	55	48	48	38	14	0	0	--

1/ M Q = Middle layer 7th stack. T B = Top layer near bunker. T D = Top layer near door. B B = Bottom layer near bunker. B D = Bottom layer near door.

2/ Record incomplete because clock mechanism of thermometer stopped on route.

Table 6 - Transit temperatures and ripening in transit of mature green tomatoes shipped from Edison, California in November 1942

Test No.	Date shipped	Loading point	Loading temp.	Type of car	Time on route	Position in car	Temperature on route		Condition on arrival					
							Av.	Min	Grn.	Pink	Red	Ripe	Decay	Virus
			°F		Days	1/	°F	°F	pct.	pct.	pct.	pct.	pct.	pct.
21	11/6	Edison	65	Standard	11	T D	63	60	99	1	0	0	0	few
22	11/6	Edison	72	Standard	11	T D	64	60	99	1	0	0	5	0
23	11/7	Edison	66	Standard	10	T D	64	61	98	2	0	0	6 2/	some
24	11/7	Edison	72	Standard	10	T D	65	59	99	1	0	0	2	0
						B B	61	55	99	1	0	0	2	0
25	11/13	Edison	73	Standard	14	T D	65	56	50	30	20	0	1	2
26	11/13	Edison	72	Fan car	25	T D 4/	63	53	10	20	70	0	21 3/	1

1/ T D = Top layer near door. B B = Bottom layer near bunker.

2/ Alternaria sp., early stage in pits and scars at shoulder.

3/ Cladosporium sp. and alternaria sp.

4/ Preco fan car.

Fig. 1 - Temperatures in Top Layer at Doorway of Tomato Cars, Shipped from Merced, California, July 1942 Under Different Conditions.

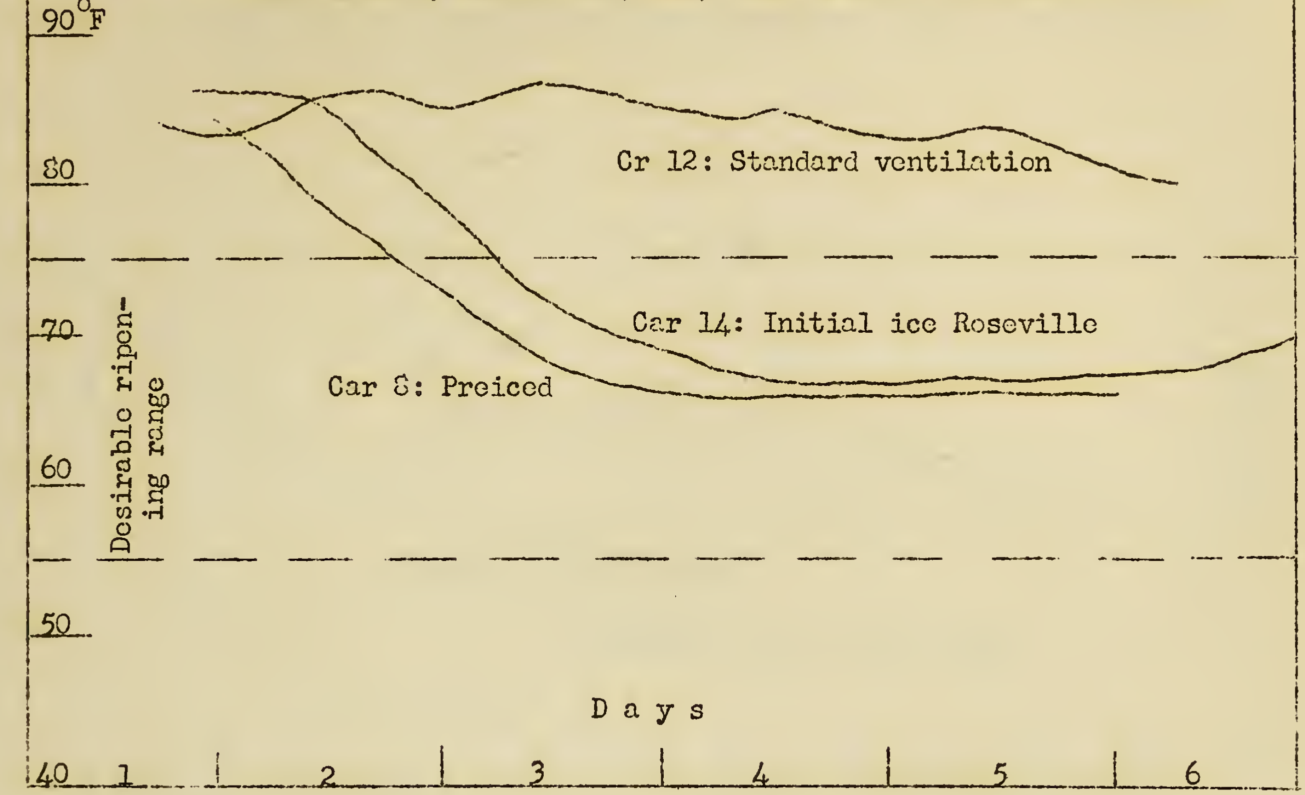


Fig. 2 - Temperatures in Different Locations of Two Cars Shipped From Merced and Le Grand, California, July 1942.

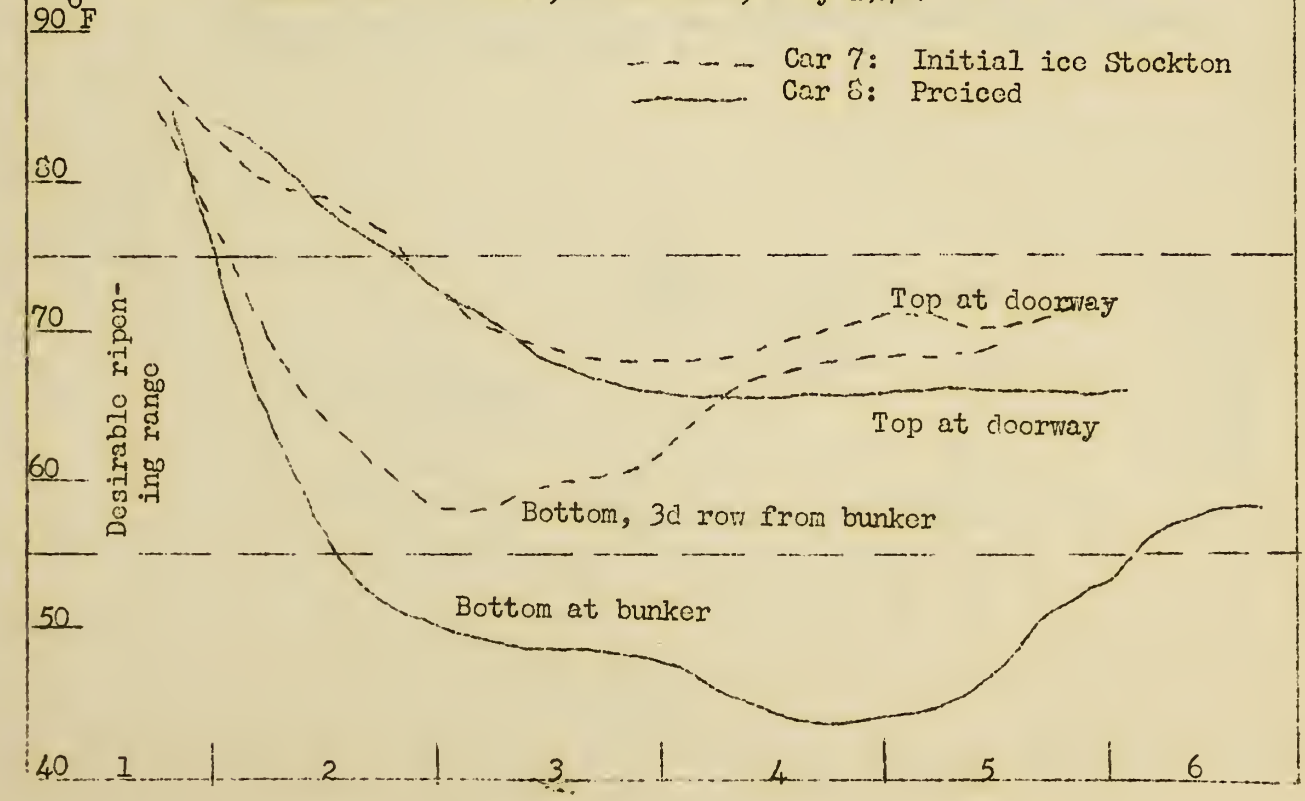


Fig. 3 - Temperatures in Different Locations of Test Car 17. Brentwood, California to Boston, Mass. October 1 - 14. Initial ice at Brentwood One Ventilator Each End Open to Ogden, Utah, Standard Ventilation Beyond.

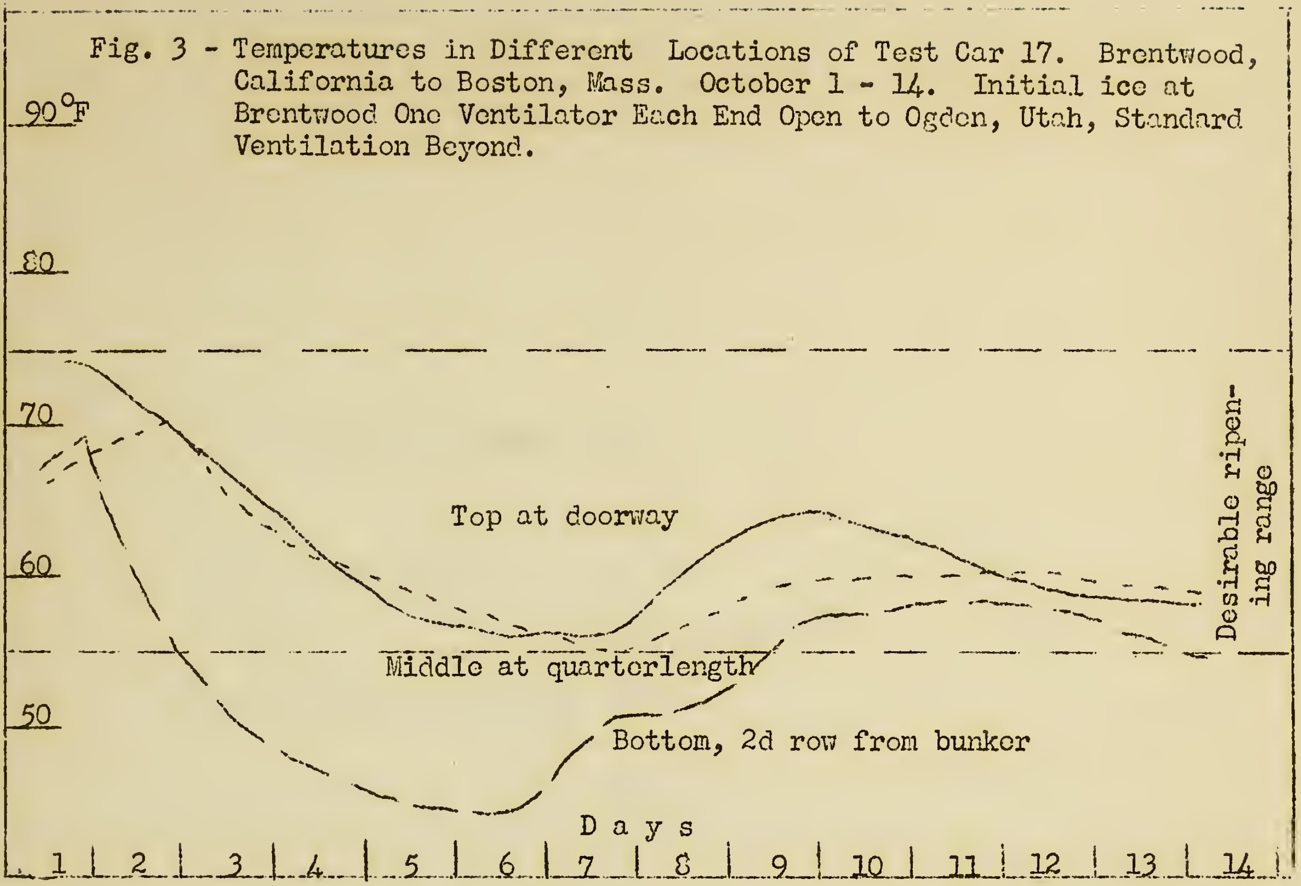


Fig. 4 - Temperatures in Different Locations of Test Car 18. Brentwood California to New York City, October 1 - 14. Initial ice at Brentwood, Fans (Preco) On, One Ventilator Each Open to Ogden Standard Ventilation Beyond

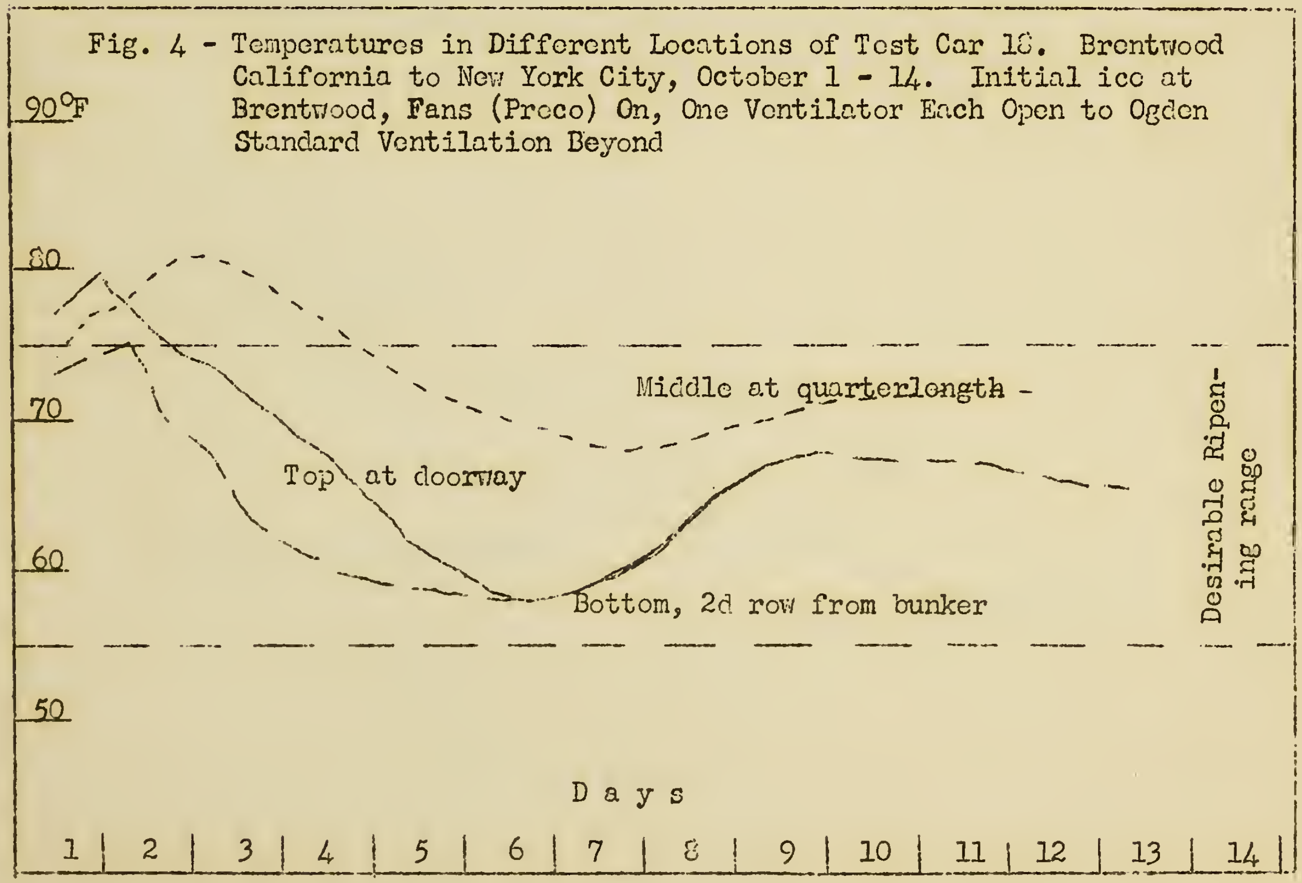
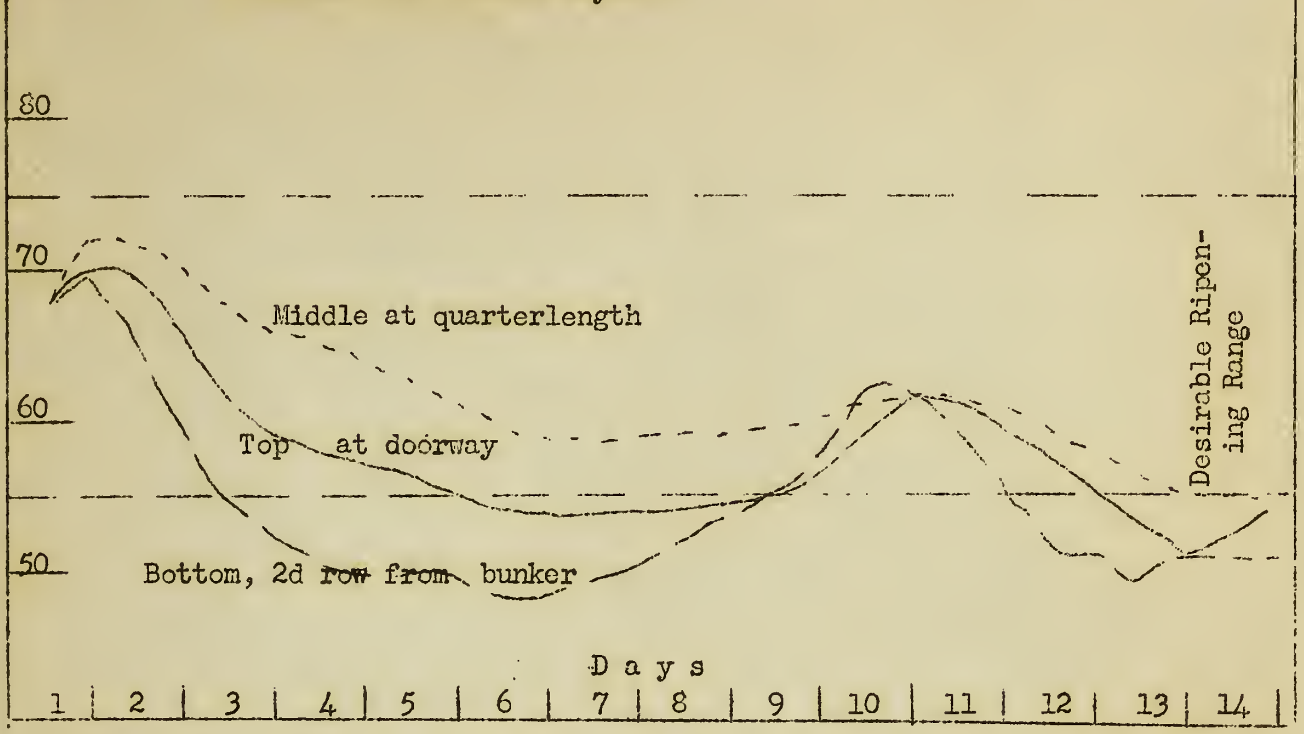
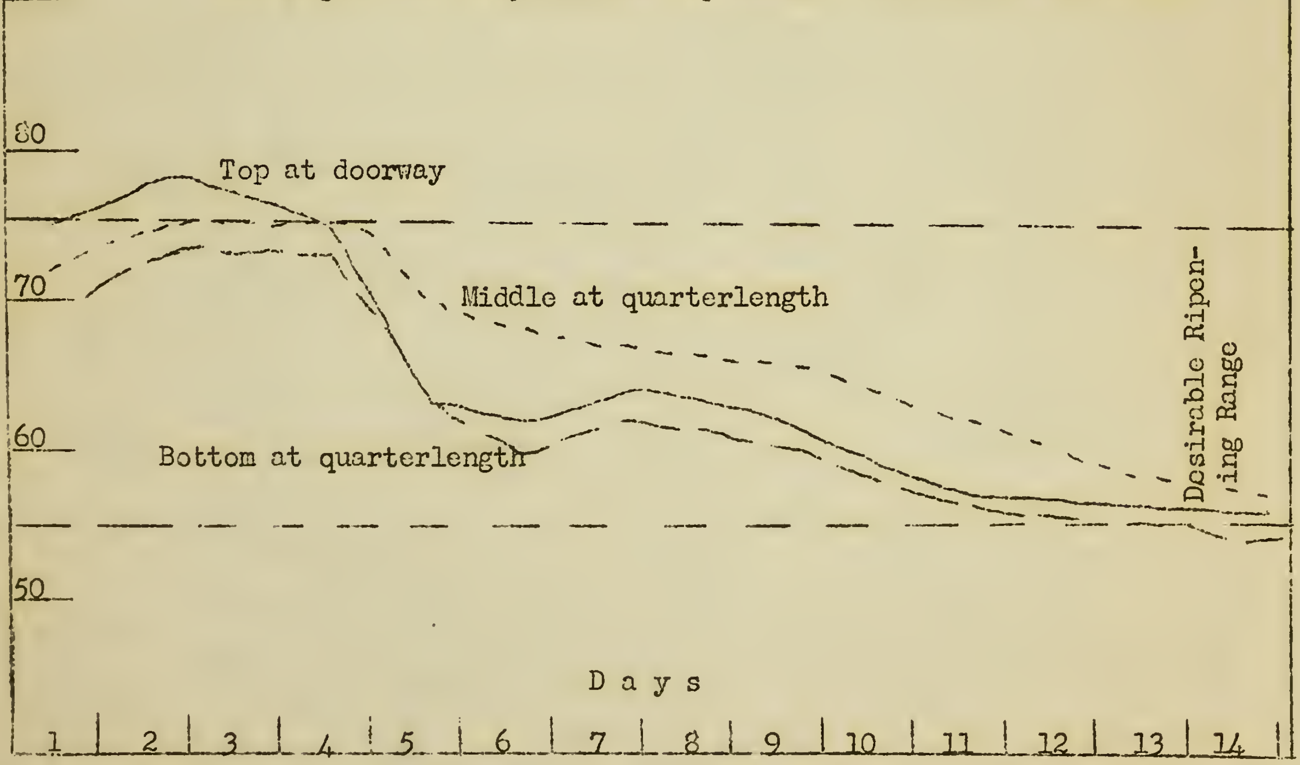


Fig. 5 - Temperatures in Different Locations of Test Car 19. Brentwood, California to New York City, October 21 - November 3. Initial Stage Icing at Brentwood, One Ventilator Each End Open to Ogden, Standard Ventilation Beyond.



Fig. 6 - Temperatures in Different Locations of Test Car 25. Edison, California to Chicago, Illinois November 12 - 27. On Track at Origin Three Days Before Departure. Standard Ventilation.